



2024 「中技社科技獎學金」

2024 CTCI Foundation Science and Technology Scholarship

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Accelerated photocatalytic degradation of furaltadone antibiotic over a dual Z-scheme $\text{Er}_2\text{Sn}_2\text{O}_7/\text{NiS}_2/\text{V}@g\text{-C}_3\text{N}_4$ heterostructure by persulfate under visible-light irradiation: DFT, Toxicity, and Antibacterial activity studies

可見光照射下過硫酸鹽在雙 Z 型 $\text{Er}_2\text{Sn}_2\text{O}_7/\text{NiS}_2/\text{V}@g\text{-C}_3\text{N}_4$ 異質結構上加速呋喃他酮抗生素的光催化降解：DFT、毒性和抗菌活性研究

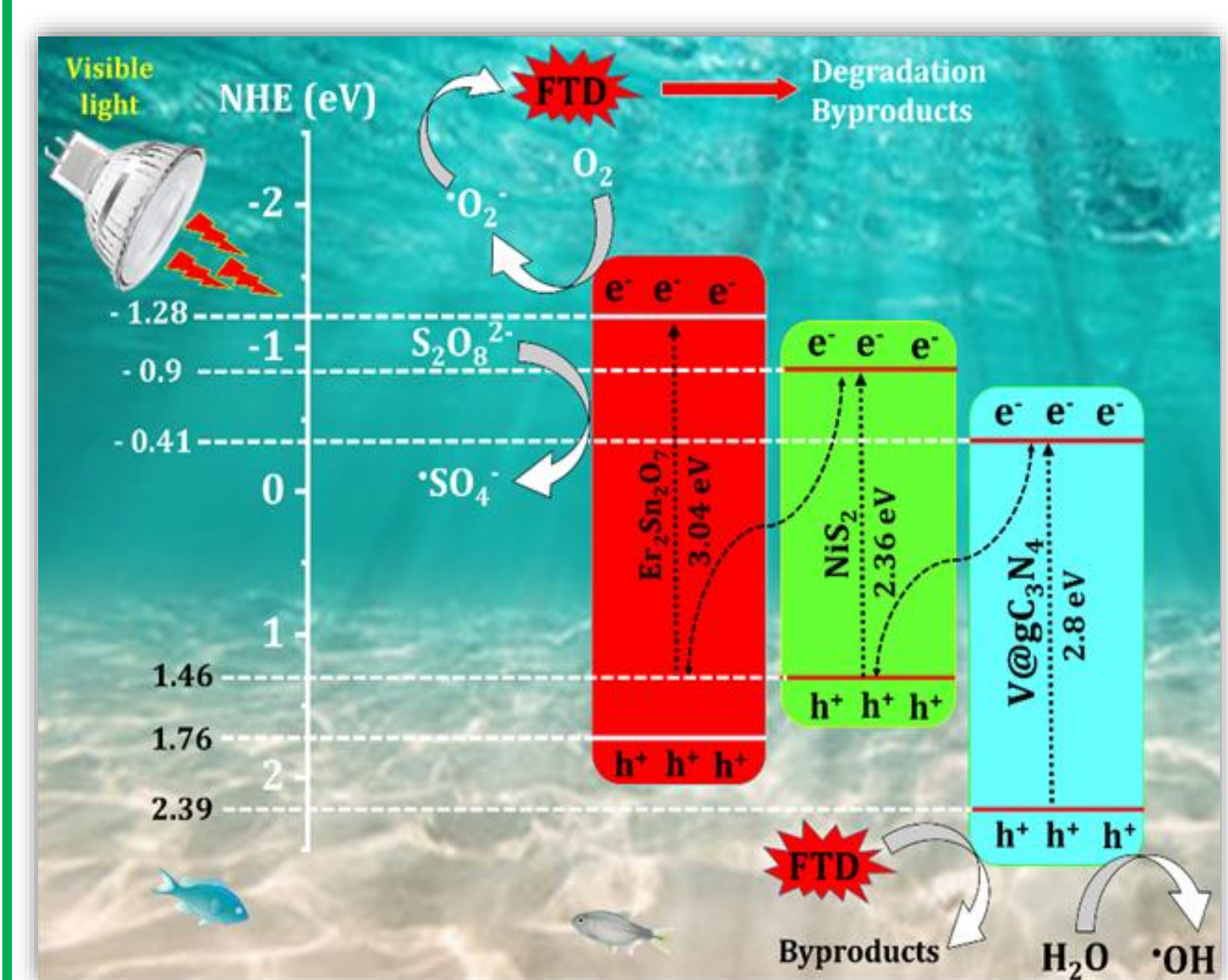
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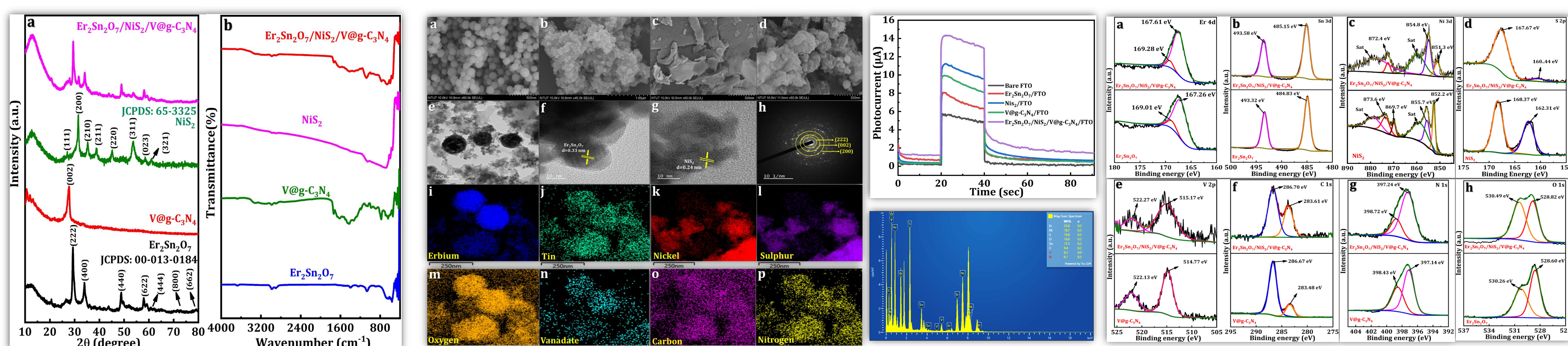
ABSTRACT

Effective photodegradation of water pollutants depends on developing highly efficient photocatalysts that can efficiently use visible light and promote the quick movement of photoinduced charge carriers. A novel dual Z-scheme $\text{Er}_2\text{Sn}_2\text{O}_7/\text{NiS}_2/\text{V}@g\text{-C}_3\text{N}_4$ heterostructure photocatalyst was successfully prepared using a hydrothermal approach followed by mechanical grinding. The $\text{Er}_2\text{Sn}_2\text{O}_7/\text{NiS}_2/\text{V}@g\text{-C}_3\text{N}_4$ composite exhibited 81.39% furaltadone (FTD) photodegradation efficiency within 90 min when combined with persulfate (PS). In the present system, a pseudo-first-order rate constant ($k = 0.0421 \text{ min}^{-1}$, $R^2 = 0.991$) was found. Furthermore, work function calculations validated the presence of a dual Z-scheme charge-migration pathway in the $\text{Er}_2\text{Sn}_2\text{O}_7/\text{NiS}_2/\text{V}@g\text{-C}_3\text{N}_4$ system. Theoretical calculations and experimental studies proposed a photocatalytic mechanism, potential intermediates, and photodegradation pathways. According to scavenger studies, the main active species were h^+ , O_2^- , $\text{SO}_4^{\cdot-}$, and $\cdot\text{OH}$. Biototoxicity assessments of the degraded FTD solution confirmed that the toxicity was lower than that of the initial solution, as confirmed by mung-bean germination and *S. aureus* cultivation experiments.

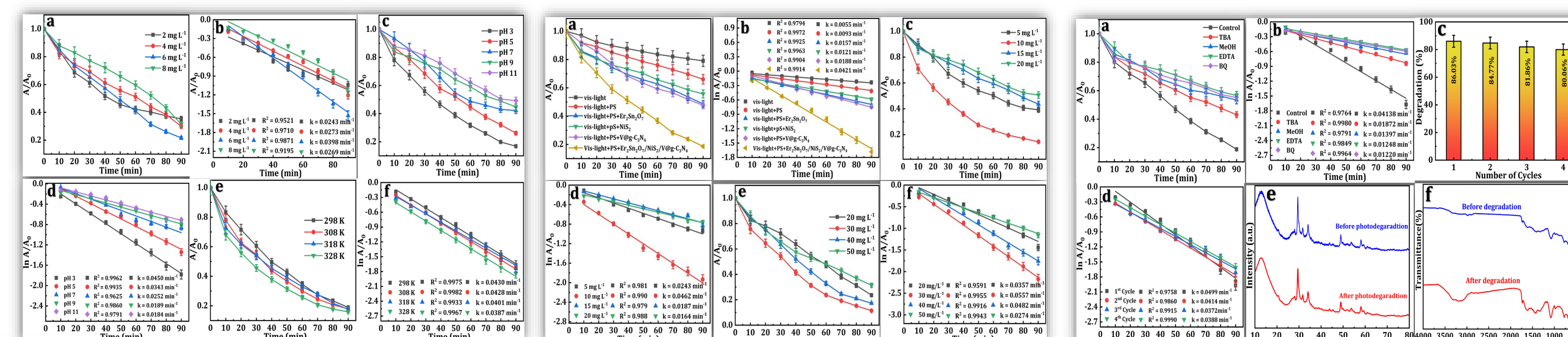
Proposed mechanism



Physicochemical properties



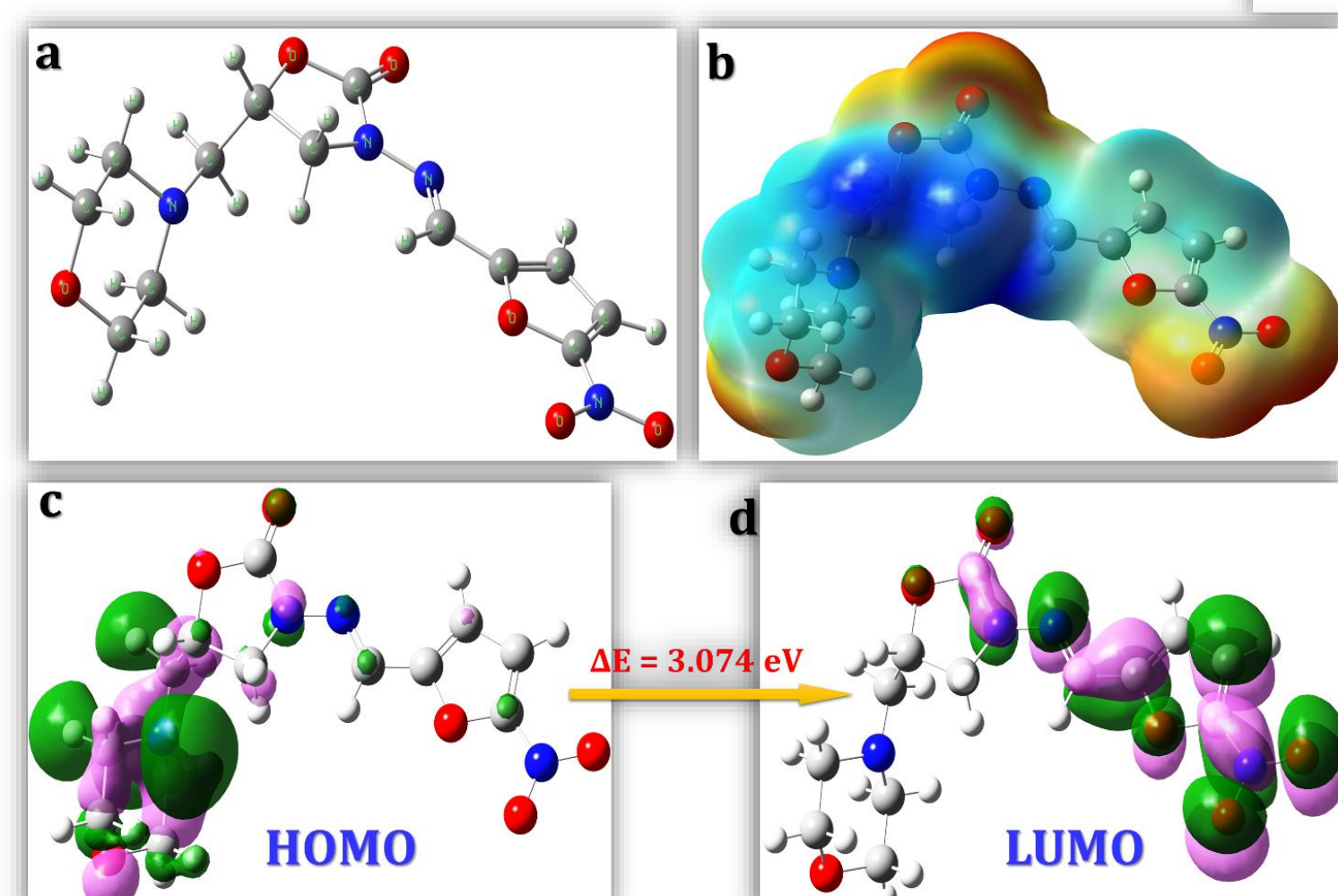
Photocatalytic activity



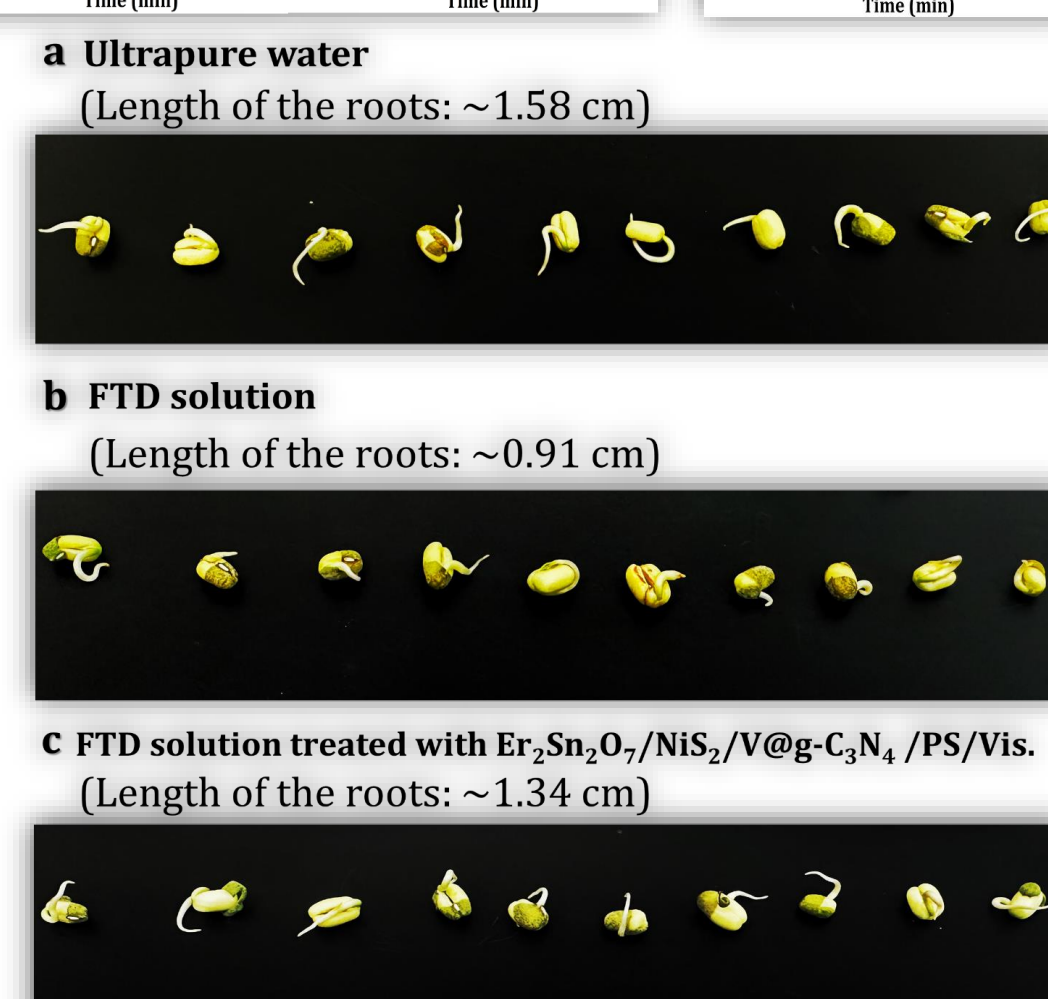
Selected publications

- Sanjay Ballur Prasanna, Rajalakshmi Sakthivel, Karthik Chimatahalli Shanthakumar, Santhosh Arehalli Shivamurthy, Yu-Chien Lin, Udesh Dhawan, Xinke Liu, Ren-Jei Chung, "Dual Z-scheme $\text{Pr}_2\text{Sn}_2\text{O}_7/\text{P}@g\text{-C}_3\text{N}_4/\text{SnS}_2$ heterojunctions for the removal of tetracycline antibiotic by persulfate activation: Kinetics, thermodynamic parameters, density functional theory, and toxicity studies," *Chemical Engineering Journal*, Volume 479, 1 January 2024, 147796, doi: <https://doi.org/10.1016/j.cej.2023.147796>.
- Sanjay Ballur Prasanna, Gagankumar Sakleshpur Kumar, Rajalakshmi Sakthivel, Karthik Chimatahalli Shanthakumar, Lu-Yin Lin, Yeh-Fang Duann, Yu-Chien Lin, Yu-Chun Lu, Ren-Jei Chung, "Dual Z-scheme heterojunction $\text{Ce}_2\text{Sn}_2\text{O}_7/\text{Ag}_3\text{PO}_4/\text{V}@g\text{-C}_3\text{N}_4$ for increased photocatalytic degradation of the food additive tartrazine, in the presence of persulfate: Kinetics, toxicity, and density functional theory studies," *Environmental Pollution*, Volume 356, 1 September 2024, 124196, doi: <https://doi.org/10.1016/j.envpol.2024.124196>.
- Sanjay Ballur Prasanna, Rajalakshmi Sakthivel, Santhosh Arehalli Shivamurthy, Yu-Chien Lin, Xinke Liu, Jung-Chih Chen, Ting-Yu Liu, Ren-Jei Chung, "Catalytic degradation of tetracycline using marigold flower-like structure erbium molybdate decorated on sulphur-doped $g\text{-C}_3\text{N}_4$ nanocomposite: Kinetics, thermodynamics, DFT calculations, and toxicity studies," *Separation and Purification Technology*, Volume 330, Part C, 1 February 2024, 125439, <https://doi.org/10.1016/j.seppur.2023.125439>.
- Sanjay Ballur Prasanna, Aboud Ahmed Awadh Bahajaj, Yi-Hsuan Lee, Yu-Chien Lin, Udesh Dhawan, Rajalakshmi Sakthivel, Ren-Jei Chung, "Highly responsive and sensitive non-enzymatic electrochemical sensor for the detection of $\beta\text{-NADH}$ in food, environmental and biological samples using AuNP on polydopamine/titanium carbide composite," *Food Chemistry*, Volume 426, 15 November 2023, 136609, doi: <https://doi.org/10.1016/j.foodchem.2023.136609>.

DFT studies



Toxicity



antibacterial studies

